.times. 10.sup.5 and having a melting point. . .

CLAIMS:

CLMS(2)

2. The process according to claim 1, in which said polyethylene is a polyethylene film.

CLAIMS:

CLMS(3)

3. The process according to claim 1, in which said polyethylene is a polyethylene fiber.

CLAIMS:

CLMS(7)

7. The process according to claim 1, in which said extending of the crosslinked polyethylene is conducted biaxially in the range of 2.5 .times. 2.5 to 3.5 .times. 3.5 times.

CLAIMS:

CLMS(8)

8. The process according to claim 1 in which said extending of the crosslinked polyethylene is conducted uniaxially in the range of 6 to 10 times.

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     (FILE 'USPAT' ENTERED AT 15:57:00 ON 27 SEP 1998)
L1          63 S 522/1/CCLS
L2         322 S L1 OR 525/333.8/CCLS
L3         371 S L2 OR 522/150/CCLS
L4         527 S L3 OR 522/161/CCLS
L5         574 S L4 OR 264/405/CCLS
L6         670 S L5 OR 264/435/CCLS
L7           3 S L6 AND (UHMWPE OR ULTRA HIGH MOLECULAR WEIGHT POLYETHYLE
NE)
L8           0 S L7 AND CRYSTAL
L9         234 S L6 AND POLYETHYLENE
L10         14 S L9 AND ((CRYSTALLINE OR CRYSTAL OR MOLECULAR) (P) ORIENT
ATI
L11          0 S L10 AND SLIGHTLY CROSSLINKED
L12          1 S L10 AND CRYSTAL PLANES
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US PAT NO: 3,886,056 [IMAGE AVAILABLE] L12: 1 of 1
TITLE: Process for producing a high melting temperature polyethylene employing irradiation and orienting
US-CL-CURRENT: 522/161; 264/210.8, 479, 485, 488; 522/912

ABSTRACT:
A process for producing a high melting temperature polyethylene which comprises irradiating a polyethylene with an ionizing radiation to produce crosslinked polyethylene having a gel content of at least one weight percent, extending the crosslinked polyethylene in at least one direction at a temperature at least an anisotropic melting point of the crosslinked polyethylene and cooling the crosslinked polyethylene, said starting polyethylene having a viscosity average molecular weight of at least 1 .times. 10.sup.5 and having a melting point of 137.degree. to. . .

SUMMARY:

BSUM(1)

The present invention relates to a process for preparing polyethylene having highly raised melting and softening temperatures and improved transparency with excellent dimensional stability at high temperatures from polyethylene having a high crystallinity.

SUMMARY:

BSUM(2)

As knwon in the art polyethylene polymers made by the so-called low pressure or medium pressure polymerization procedure usually have high crystallinity, of which those having. . .

SUMMARY:

BSUM(3)

Although polyethylene of this kind has found versatile applications because of the above mentioned characteristics, there are some properties to be improved.. . .

SUMMARY:

BSUM(4)

To improve these properties various attempts have been made. For example, it has been proposed to irradiate polyethylene moldings such as bottle, container, etc. with ionizing radiation for crosslinking thereof. Although the polyethylene thus irradiated has improved dimensional stability at high temperatures, melting point as well as softening point thereof can not be. . .

SUMMARY:

BSUM(5)

Procedures for preparing polyethylene of high melting temperature have been recently developed without irradiation crosslinking. Those procedures comprise the crystallization of the polymer either. . . shear or from the molten drop with an extremely high rate of quenching under high shear. It was reported that polyethylene strand or film made by those procedures had a very high melting temperature, for example, of 150.degree.C with excellent transparency. In any case, to prepare polyethylene of very high melting temperature through above-cited procedures, very severe conditions such as extremely high pressure are essential.

SUMMARY:

BSUM(6)

An object of the invention is to provide a process for producing polyethylene having a highly raised melting point as well as softening point.

SUMMARY:

BSUM(7)

Another object of the invention is to provide a process for producing polyethylene having excellent dimensional stability at high temperatures.

SUMMARY:

BSUM(8)

Another object of the invention is to provide a process for producing polyethylene having excellent transparency.

SUMMARY:

BSUM(9)

Another object of the invention is to provide a process for producing polyethylene having the above excellent properties with simple procedures.

SUMMARY:

BSUM(11)

The process of the present invention comprises irradiating a polyethylene with an ionizing radiation to produce crosslinked polyethylene having a gel content of at least one weight percent, extending the crosslinked polyethylene in at least one direction at a temperature of at least anisotropic melting point of the crosslinked polyethylene and cooling the crosslinked polyethylene, said starting polyethylene having a viscosity average molecular weight of at least 1 .times. 10.sup.5 and having a melting point of 137.degree. to. . .

SUMMARY:

BSUM(12)

Throughout the specification and claims "gel content" is intended to mean the amount in weight percent of polyethylene insoluble in boiling xylene, based on the weight of the total amount of the polyethylene tested.

SUMMARY:

BSUM(13)

According to the researches of the present inventors it has been found that when the above specific polyethylene is subjected to irradiation crosslinking to a proper degree crosslinked polyethylene having high elasticity in a molten state can be obtained without decreasing melting point of the polymer and that when. . .

SUMMARY:

BSUM(14)

The starting polyethylene to be used in the invention is selected from those made by low or medium pressure polymerization of ethylene. Employable. . . the melting point of the polymer obtained by isothermal crystallization is not sufficiently high, the same drawback will result. Generally, polyethylene avaialable in the art and having a viscosity average molecular weight of less than 4 .times. 10.sup.6 can be used in the invention. Preferably molecular weight is in the range of 2 .times. 10.sup.5 to 1 .times. 10.sup.6. The polyethylene is used in the invention in the form of fiber, film and sheet.

SUMMARY:

BSUM(15)

In accordance with the present invention, the starting polyethylene is first crosslinked by irradiation with an ionizing radiation so as to produce crosslinked polyethylene having a gel content of at least one weight percent. Preferable examples of ionizing radiation are X-ray, .gamma.-ray, electron beams,. . . step. Gel content of 95 weight percent which is usually the upper limit of gel content by radiation crosslinking of polyethylene is effective in the invention, but preferable gel content is usually in the range of 40 to 70 weight percent.. . . such as nitrogen. The dosage of the ionizing radiation may vary over a wide range in accordance with the starting polyethylene to be used, temperature, atmosphere, gel content of the polymer to be obtained and other factors. For example, the higher. . .

SUMMARY:

BSUM(16)

According to the inventio e crosslinked polyethylene is then extended or stretched in t olten state at a temperature of at le anisotropic melting point of the. . . Conventional extending means are applicable to the invention. For example, a conventional continuous drawing equipment may be used for stretching polyethylene fibers and films. Further, rolling and inflation apparatuses known in the art can be used for polyethylene films. If transparent polyethylene film or sheet is to be obtained, it is preferable to conduct the extending under an increased pressure. Such increased. . .

DETDESC:

DETD(2)

A molecular weight fraction with a viscosity average molecular weight of 3.4 .times. 10.sup.6 was obtained from a high density polyethylene by a liquid-liquid phase separation technique disclosed by H. Okamoto et al in J. Polymer Sci., 55, 597 (1961). Said high density polyethylene had a viscosity average molecular weight of 2.5 .times. 10.sup.6 and a melting point of 137.2.degree.C when crystallized isothermally at. . .

DETDESC:

DETD(7)

As listed above, although the macroscopic density and accordingly the degree of crystallinity are not so high as crystalline polyethylene, the melting temperature is the highest of all the values reported for polyethylene up to date. Furthermore, the unit-cell density determined by X-ray diffraction technique is the highest of all the values reported for polyethylene. This indicates the existence of a very pure crystalline phase in the sample. Furthermore, X-ray studies revealed that this sample has a very special orientation of the crystalline phase so that the crystal planes (110) or (200) in this sample are oriented almost parallel to the film plane.

DETDESC:

DETD(10)

The . . . fraction obtained in the same manner as above directly at 190.degree.C with a pressure of 50 kg/cm.sup.2 to produce a polyethylene film of about 0.19 mm in thickness. In comparison with the reference sample, the present sample has very high moduli,. . .

DETDESC:

DETD(12)

About 1.5 mm thick film of the high density polyethylene the same as in Example 1 was irradiated to 2.7 Mega rads at room temperature under vacuum with electron beam. . .

DETDESC:

DETD(17)

1.5 mm thick film of unfractionated "Marlex 50" (Trade mark, high density polyethylene of the Phillips Petroleum Comp., U.S.A.) having a viscosity average molecular weight of 136,000 and a melting poing of 137.5.degree.C. . .

DETDESC:

DETD(25)

It is impossible to draw non-crosslinked polyethylene fibers in the molten state and it is usually drawn in a temperature range lower than 120.degree.C. However, the irradiated. . .

CLAIMS:

CLMS(1)

What we claim is:

1. A process for producing a high melting temperature polyethylene which comprises irradiating a polyethylene with X-rays, .gamma.-rays or electron beam to a dosage of from 0.2 to 16 Megarads to produce crosslinked polyethylene having a gel content of at least one weight percent, extending the crosslinked polyethylene in at least one direction at a temperature of at least the anisotropic melting point of at least 150.degree.C of the crosslinked polyethylene and cooling the crosslinked polyethylene, said starting polyethylene having a viscosity average molecular weight of from 1 .times. 10.sup.5 to 4